RECONFIGURABLE USER INTERFACE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Patent Application No. 60/523,433 filed November 18, 2003, the entire disclosure of which, including the specification and drawings, is expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0001] The present invention relates to user interfaces and displays and in particular to a user interface in a vehicle that is reconfigurable and provides visual and tactile feedback to a user.

BACKGROUND OF THE INVENTION

[0002] Touch screens or displays, e.g., plasma or LCD displays are commonly used to provide a user interface and to receive command and control inputs from a user. Touch screens include a transparent membrane that when depressed at certain locations activates a switch to execute a particular function. A touch screen may be coupled to, for example, electrical switches. Touch screens may be utilized as a user interface in numerous applications such as appliances, electronics equipment, for devices in a vehicle, etc. Typically, touch screens are flat (two dimensional) and require visual contact from a user while actuating a region on the touch screen coupled to a membrane switch or contact or a mechanical switch. This may be problematic for systems or devices in a vehicle as drivers would have to keep their eyes off of the road while selecting and actuating a switch using the touch screen. In addition, touch screens may acquire fingerprints and dirt from direct contact by users. A flat touch screen may also be difficult to see from different angles, for example, a passenger in a vehicle may have difficulty viewing and using a touch screen in the vehicle that is positioned for easier viewing by the driver of the vehicle.

[0003] It would be advantageous to provide a user interface for a touch screen or display that is configured to provide tactile feedback to a user so the user may identify when they are making contact with a particular region (e.g., a button) and actuate a switch associated with the region with minimal visual contact. In addition, it would be advantageous to provide an interface that includes buttons (or contact regions) that may be reconfigured by changing a display visible through the interface.

SUMMARY OF THE INVENTION

[0004] In accordance with one embodiment, a user interface for receiving inputs from a user includes a touch sensitive surface having a plurality of regions, each region corresponding to a switch having a function and an interface disposed on the touch sensitive surface over at least one of the plurality of regions, the interface comprising a material that is at least partially transparent and configured to provide tactile feedback to the user. The interface may comprise at least one button disposed over a region. The function corresponding to a button may be reconfigured by at least changing light emitted from the touch sensitive surface. The touch sensitive surface may emit light that is visible through the interface. The interface may further include a plurality of buttons disposed over the plurality of regions wherein the light is selectively provided to each of the plurality of buttons. The user interface may be mounted in, for example, a vehicle.

[0005] In accordance with another embodiment, a user interface for a vehicle includes a plurality of switches, each switch corresponding to a function, an interface disposed over at least one of the plurality of switches, the interface comprising a material that is at least partially transparent and configured to provide tactile feedback to a user, and a display disposed beneath the interface, the display configured to provide display signals corresponding to the function of each switch, the display being visible through the interface.

[0006] In accordance with another embodiment, a user interface system for a vehicle includes a display, an interface disposed over the display and comprising a material that is at least partially transparent and configured to provide tactile feedback to a user, the interface including a plurality of contact regions, where each contact region corresponds to a switch having a function, a control circuit coupled to the display and the interface, the control circuit configured to receive control data from the interface in response to actuation of a contact region, to provide the control data to a vehicle system based on the corresponding switch function and to provide display signals to the display based on the corresponding switch function, and a memory coupled to the control circuit and configured to store display data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The invention will be more readily understood by reference to the following description taken with the accompanying drawings, in which:

[0008] FIGS. 1A-1C are schematic block diagrams of a cross-section of a user interface and display in accordance with an embodiment.

[0009] FIG. 2 is a schematic diagram of an exemplary interface in accordance with an embodiment.

[0010] FIG. 3 is a perspective view of an exemplary rotary type switch the may be emulated on an interface in accordance with an embodiment.

[0011] FIG. 4 is a schematic block diagram of a reconfigurable user interface system in a vehicle in accordance with an embodiment.

[0012] FIG. 5 shows an exemplary menu display for a user interface in accordance with an embodiment.

[0013] FIG. 6 shows an exemplary display and user interface for a vehicle in accordance with an embodiment.

[0014] FIG. 7 shows an exemplary display and user interface for a vehicle in accordance with an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED AND OTHER EXEMPLARY EMBODIMENTS

[0015] Figures 1A-1C are schematic block diagrams of a cross-section of an interface and display in accordance with an embodiment. In Figure 1A, an interface 100 is disposed over a touch screen or display 102 such as a plasma touch screen, LCD touch screen, etc. The touch screen or display may be any known touch sensitive screen or display (e.g., a capacitive touch screen, a resistive touch screen, etc.) that includes at least one membrane switch or contact covered by a membrane 106 capable of sensing pressure. Membrane 106 and button/pad 110 are at least partially light permeable, e.g., transparent, translucent, etc. A membrane switch may be actuated by applying pressure, e.g., by a user's finger, to a button or pad 110 disposed over the membrane switch of touch screen film 106. In an alternative embodiment shown in Figure 1B, a switch 112 (e.g., a mechanical or electrical switch) may be located beneath a transparent button or membrane 110 such that when pressure is applied, the switch is activated. In another embodiment, shown in Figure 1C, a switch 112 (e.g., a mechanical or electrical switch) may be located to the side of display 102 (e.g., a LCD display). A transparent button 110 is disposed over the display screen 102 and is coupled to switch 112. When pressure is applied to button 110, switch 112 is activated.

[0016] Returning to Figure 1A, interface 100 includes a bezel or mask 108 (e.g., a plastic bezel) that includes an aperture that may be disposed over a membrane switch of touch screen film 106 for display 102. A button or pad 110 is disposed within the aperture and may be coupled to bezel or mask 108. Button 110 may be fabricated from a flexible material that is

at least partially semi-transparent or transparent (or semi-translucent, translucent, opaque, light permeable) such as silicon, polycarbonate, other plastics, etc. In addition, the material used for button(s) 110 may be washable. Interface 100 may be configured to include a plurality of buttons or pads 110 that are disposed over at least one membrane switch of touch screen 106. Accordingly, interface 100 may have a mask 108 that includes multiple apertures for multiple buttons or pads 110. Interface 100 advantageously provides multiple buttons or pads corresponding to various switch types, as described further below. Interface 100 may protect the underlying touch screen film 106 and/or display 102.

[0017] Light from the touch screen or display 102, e.g. a color, text or graphics 104, may advantageously be viewed through the button or pad 110 of the interface 100. When button 110 is depressed or pressure applied, the button makes localized contact with the touch screen film 106 to actuate the membrane switch to activate an assigned function of the membrane switch. In the embodiments shown in Figures 1B and 1C, when button 110 is depressed or pressure is applied, the switch 112 is actuated to activate an assigned function of switch 112. Button 110 is transparent so that light 104 from display 102 is visible through button 110.

[0018] Buttons or pads 110 of interface 100 may take various different forms or shapes to emulate different types of switches or control/input devices such as a joystick, a rocker switch, a rotary switch, a toggle switch, a four-point rocker switch, a D-pad, multi-access switch, a jog dial, a slider switch, etc. as shown in Figures 2 and 3. In Figure 2, an interface 202 is shown. As mentioned, interface 102 may be disposed over a touch screen or display (not shown). Interface 202 includes various forms of buttons or pads such as a slider switch 210 or a four-point rocker 208. The buttons or pads of interface 202 are advantageously three-dimensional and, therefore, provide tactile feedback to a user. Accordingly, a user may identify when they are making contact with a particular button. For example, slide switch 210 may be formed by creating a depression or trough in a button or pad that has defined endpoints. A user may slide a finger across the tough and have tactile feedback when the endpoints have been reached. A button or pad in the form of a slide switch 210 may be used, for example, to control a volume function of an audio system in a vehicle. The three-dimensional, tactile feature of the buttons/pads on interface 202 may allow a user, such as a driver of the vehicle, to actuate the switch with minimal visual contact. Interface 202 may be further configured to include other tactile feedback such as a vibration or to provide audible feedback such as a beep or click sound. In addition, the three-dimensional buttons or pads may be more easily visible to users at various locations as a result of the light visible (or piped) through the buttons/pads of the interface from a display disposed beneath the interface.

[0019] Figure 3 shows an exemplary rotary type switch that may be emulated on the interface 100 in accordance with an embodiment. A rotary type button/pad 304 may be used to control functions such as volume, etc. By twisting the button 304, buckle points are created that push left or right and make contact with the membrane switch of the touch screen. In other words, the side of the button 4304 will collapse (buckle points) as a rotary load is applied and activate the switch. While there is contact between the button and the membrane switch, the display of the touch screen may change the text or graphics highlighted or shown. In Figure 3, a graphic 302 showing the number three is highlighted. A reference point 306 shown on the touch screen may also be viewed on the rotary type button 304. In the exemplary embodiment of Figure 3, as a user continues to apply a rotary load to the button in a clockwise direction, the successive numbers, 4, 5, 6, etc. may be highlighted. The user may stop twisting the button to selected the desired item. As mentioned above, other tactile feedback, such as a vibration, or audible feedback, such as a beep sound, may be provided for rotary switch 304.

[0020] Returning to Figures 1A-1C, as mentioned above, the touch screen or display 102 provides light 104 in the form of colors, graphics, text, etc. that is visible through the buttons 110 of interface 100. For example, display 102 may provide a menu (e.g., text, graphics or both) for various functions. An exemplary menu display is shown in Figure 5. Display menu 500 shown in Figure 5 includes graphics and text representing a particular function that may be controlled using a button (i.e., of an interface disposed over the display) and switch (e.g., a membrane switch) corresponding to the graphic or text. For example, menu 500 in Figure 5 illustrates various vehicle functions such as audio 504, temperature 502 or 506, fan level 508, etc. When a particular function is selected (i.e., by depressing a button on of an interface as described above), a different menu (i.e., part of a hierarchical menu tree associated with a particular function or system) may be displayed and the function corresponding to a particular switch and button may chance. For example, a further menu or display related to navigation functions may be shown by selecting the button and membrane switch 510 labeled "nav" on display 500. In this manner, the touch screen or display may be used to show multiple different menu's or displays and thereby the function of the buttons of interface 100 (shown in Figure 1A) may be changed based on the screen or menu display. Accordingly, the buttons/switches of an interface may be reconfigured and changes in the functions may be conveyed to a user by the text, graphics, light, etc. from display 102 (shown in Figure 1A) viewed through the interface 100. In another example, buttons that correspond to a switch that has an assigned function may be lit while buttons that correspond to switches

that have not been assigned a function (e.g., based on the current menu being displayed) may not be lit. As mentioned, the light used to illuminate different buttons or pads may be different colors.

[0021] Referring to Figure 1A, the menus/displays provided (e.g., the text, graphics or light patterns) on display 102 as well as the functions corresponding to the items on the menu/display may be controlled by, for example, software provided in a control module coupled to the touch screen or display 102. Figure 4 is a schematic block diagram of a reconfigurable user interface system in a vehicle in accordance with an embodiment. A display 402 (e.g., an LCD display, a plasma touch screen display, etc.) is coupled to a control circuit 414. Display 402 includes a user interface 404 and may be mounted in, for example, an overhead console, although it may be mounted at any conveniently accessible location within easy reach of the vehicle operator, such as in an instrument panel, dashboard, visor, rearview mirror or other appropriate location in the vehicle. Control circuit 414 may comprise one or more analog and/or digital electrical or electronic components, and may include a microprocessor, microcontroller, application-specific integrated circuit (ASIC), programmable logic, and/or other analog and/or digital circuit elements configured to perform the various functions to be described herein. Control circuit is coupled to a memory 418, including volatile and non-volatile memory to, for example, store a computer program or other software to perform the functions described herein. In addition, control circuit 414 is coupled to various vehicle systems 416 such as a navigation system , an audio system, an HVAC system, a hands-free telephone system, etc.. Each element in vehicle 400 shown in Figure 1 may be mounted in the same or different interior vehicle elements such as a dashboard, an overhead console, an instrument panel, a visor, a rearview mirror, or other appropriate location in the vehicle.

[0022] Memory 418 is configured to store display and menu information for various vehicle functions (e.g., navigation functions, volume and other audio system functions, etc.). Control circuit 414 is configured to retrieve display data (e.g., a menu, a portion of a hierarchical menu tree or a particular function) from memory 418 and provide the display data to display 402. User input received via display 402 and user interface 404 is provided to control circuit 414 which is configured to provide the control data to an appropriate vehicle system 416, such as a navigation system, an audio system, a hands-free telephone system, etc. For example, if a button corresponding to a volume function of an audio system is actuated to lower the volume, control circuit 414 receives the control data and provides the data to the audio system such that the volume may be controlled. In addition, control circuit 414 may

provide display signals to display 402 such that the display visible through user interface 404 may indicate the change in volume to a vehicle occupant. Control circuit 414 is also configured to provide other feedback control signals for a particular button of user interface 404, such as to provide tactile feedback (e.g., a vibration), audible feedback (e.g., a click sound), etc. related to the particular type and function of the button.

[0023] FIG. 6 shows an exemplary display and user interface for a vehicle in accordance with an embodiment. In Figure 6, an instrument panel 600 having a touch screen is shown. An interface 602 as described herein is disposed over a touch screen display and provides buttons/pads such as button 604 and rotary switch 602. FIG. 7 shows an exemplary display and user interface in accordance with an embodiment. In Figure 7, an exemplary touch screen display 700 for a hands-free telephone system is shown. An interface 702 is disposed over the touch screen and provide buttons/pads 704, 706 that may be used to select and/or control various functions of the hands-free telephone system such as answering a call 706. .

[0024] It is important to note that the construction and arrangement of the display and reconfigurable user interface as shown in the preferred and other exemplary embodiments are illustrative only. Although only a few embodiments of the present invention have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited herein. Accordingly, all such modifications are intended to be included within the scope of the present invention as described herein. The order or sequence of any processes or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and/or omissions may be made in the design, operating conditions and arrangement of the preferred and other exemplary embodiments without departing from the exemplary embodiments of the present invention as expressed herein.